DOCUMENT RESUME

ED 040 267 VT 008 466

TITLE	Nuclear Education and Training Programs of Potential Interest to Utilities.
INSTITUTION	Atomic Energy Commission, Washington, D.C.
PUB DATE	Dec 68
NOTE	51p.
EDRS PRICE	EDRS Price MF-$0.25 HC-$2.65
DESCRIPTORS	*Directories, *Educational Programs, *Engineering Education, *Nuclear Physics, *Technical Education

ABSTRACT

This compilation of education and training programs related to nuclear applications in electric power generation covers programs conducted by nuclear reactor vendors, public utilities, universities, technical institutes, and community colleges, which were available in December 1968. Several training-program consultant services are also included. These programs range from special short-courses and seminars for non-engineers to graduate courses in engineering at the Ph.D. level. An alphabetical list of schools having nuclear power engineering curriculums is included. (EM)

ED040267

NUCLEAR EDUCATION AND TRAINING PROGRAMS OF POTENTIAL INTEREST TO UTILITIES

December 1968

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
OFFICE OF EDUCATION
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Division of Nuclear Education and Training
U. S. ATOMIC ENERGY COMMISSION

ED040267

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I. INTRODUCTION

The rapidly expanding commitment of the electric power industry to nuclear power stations imposes a significant demand for competent personnel well versed in various aspects of this new technology. Utility organizations with nuclear experience have found that it is very important to develop, at an early stage, technical and management in-house nuclear capabilities in view of the unique design characteristics and safety requirement of nuclear power plants and the competitive demands for nuclear-trained personnel.

The primary responsibility for establishment and implementation of nuclear orientation and training programs for utility staffs belongs to the utilities and to the nuclear industry as a whole. However, the means for meeting the unusual requirements for specialized education and training of utility personnel are also a subject of concern to the Atomic Energy Commission.

The Commission has examined the present and potential availability and adequacy of a variety of private sources of orientation and training programs. It believes there are sufficient resources, provided utility management develops adequate advanced planning for their use. This document has been prepared with the principal objective of assisting utility management by providing information as to nuclear training and education opportunities available.

A compilation has been made of education and training programs of potential interest to utility management and technical staffs. These programs are being provided by various institutions of higher education, reactor vendors, and consulting firms. In addition, several utilities currently operating nuclear power stations have indicated a willingness to assist other utilities by providing a limited number of opportunities for individuals to participate in, or observe, actual nuclear power operations. Although the lists in this document are not necessarily complete, they do represent all the information available to AEC staff at the time of publication.

Most education and training programs specifically designed for utility management and technical personnel have been established on an ad hoc basis by negotiation between the sponsoring organization and the utility. Therefore, the costs of the program, the actual timing, and specific details of course content are not provided in this compilation for such courses or programs. We have assumed that any organization previously presenting a training program for one utility will be interested in doing it for others. It is probably true also that each organization is capable of fulfilling other needs in special circumstances. A number of universities which presented summer courses in 1968 appear willing to repeat these if demand warrants. Listing in this announcement simply represents the fact that an

organization has given a training program or has indicated interest in doing so. Listing in no way indicates an AEC recommendation.

It is assumed that the long range hiring programs of the utilities will take cognizance of the need to employ graduates directly from educational institutions as well as continuing to stress retraining of existing personnel. Therefore, the compilations include listings of technical institute, college and university degree granting programs in areas of potential interest to utilities.

The Commission hopes that these listing will aid utilities in developing their own training programs. In addition, it is hoped that this information may be a basis for the organizations listed as well as others to provide additional training information to the AEC or to develop additional utility oriented training programs. Therefore, all readers of this compilation who may wish to correct any of the contained information or to add material for a subsequent re-issue are urged to contact George W. Courtney, Jr., Assistant to the Director, Division of Nuclear Education and Training, U. S. Atomic Energy Commission, Washington, D. C., 20545. On the other hand, utility or other organizations wishing further details on specific training programs should make direct contact with the organization sponsoring the particular program.

II. REACTOR VENDORS

A. Babcock and Wilcox Company offers nuclear power training courses for management, plant operations, and technical personnel.

1. Management Level

   a. Management Seminar (2 days) is to provide concise familiarization with contemporary nuclear power plant designs, licensing, operation, safety, staffing and training, public acceptance, liability, and the fuel cycle. It is directed primarily to the general management level and is given at a location chosen by the customer.

   b. Nuclear Engineering Training (48 lecture hours) is to provide an introduction to the various design and operational features of a PWR power station, stressing safety, licensing requirements, and operating considerations. It is directed primarily to the general office management and engineering staff for use in planning and is given at the location chosen by the customer.

2. Plant Operations Level

   a. Nuclear Theory (12-16 weeks) is to provide a basic theory foundation in nuclear engineering and reactor theory featuring math, atomic physics, reactor physics, heat transfer, and is patterned to fit trainees with mixed educational backgrounds. It is directed toward operators, operator supervisors, and allied personnel. It may be given at optional locations with or without B & W participation. Many of the universities listed in another section of this release may provide this training.

   b. Pressurized Water Reactor Observation (3-5 months) is to provide customer personnel with a period of observation during which familiarity with an actual operating PWR reactor will be gained. B & W will arrange for training or will assist in making arrangements if requested. Training takes place at an operating PWR reactor.

c. PWR Technology (6 weeks),primarily for operating supervisory personnel and technical staff, is given at the B & W Training Center, Lynchburg, Va. It is to provide background on theory and PWR technology as applied to a particular plant. The course is considered fast moving and intense.

d. PWR Operation (12 weeks), for reactor operators, is given at the B & W Nuclear Training Center, Lynchburg, Va. The B & W PWR simulator and the Lynchburg Pool Reactor are used to provide operational experience required for qualification as a PWR reactor operator.

e. On-the-Job Training (10 months), takes place at the utility's plant, to provide all plant personnel with intensive operator qualification, equipment familiarization and procedural training on actual plant equipment, plus applicable theory and system design information.

3. Technical Level

a. Instrumentation and Control (4-6 weeks), given at the Bailey Meter Company, Wickliffe, Ohio, to provide detailed understanding of Bailey control concepts and equipment as related to nuclear plants. Intended for instrument and control foremen, nuclear engineers, station engineers, or central staff engineers.

b. Instrumentation and Control (3-4 weeks) given at the Bailey Meter Company, Wickliffe, Ohio, is intended to provide a detailed understanding of Bailey Control system components, installation, calibration and maintenance procedures for instrumentation and control technicians.

c. Bailey 855 Computer Operation and Programming (3 weeks), given at the Bailey Meter Company, Wickliffe, Ohio, is to provide a detailed understanding of the operation and programming of the Bailey 855 computer intended for plant computer operators and programmers.

d. Bailey 855 Computer Maintenance (6-7 weeks), given at the Bailey Meter Company, Wickliffe, Ohio, is to provide plant computer maintenance technicians with a detailed understanding of Bailey 855 computer and peripheral equipment maintenance.

e. Water and Radiochemistry (2 weeks), given at the B & W Nuclear Training Center, Lynchburg, Va., is to provide plant chemical supervisors and central staff engineers with a technical understanding of basic radiochemistry and analytical procedures, plus a detailed understanding of B & W recommended water chemistry standards.

f. Nuclear Plant Maintenance (1 week), given at the B & W Maintenance Center, Barberton, Ohio, to provide information on the conduct of maintenance procedures peculiar to PWR power stations for plant maintenance supervisors and mechanical maintenance foremen.

For more information, contact: Manager, Service Section
Nuclear Power Generation Department
Babcock and Wilcox Company
P. O. Box 1260
Lynchburg, Virginia 24505

B. Combustion Engineering

Offers a reactor operator training program to provide the customer's operating personnel (i.e., those who will take the AEC Senior Operator license examination prior to initial criticality) with the academic knowledge and practical experience required to operate, in a safe and efficient manner, the nuclear steam supply system (NSSS) furnished by Combustion Engineering, Inc.

1. Basic Nuclear Training Course (14 weeks) which consists of academic work at a university with a research reactor available for experimentation and criticality practice. A minimum of ten reactor startups and shutdowns will be performed by each trainee. Reactor experiments demonstrating basic concepts will relate the academic program to a practical understanding of reactor behavior.

2. Observation Training and Reactor Simulator Operations (6 months) This period combines two phases of training (observation training with the crew of an operating power reactor, and simulator power operations). About 4 months is allotted for observation training and 2 months for simulator operations.

3. NSSS Design Lecture Series (6 weeks) is intended to indoctrinate customer personnel in the design and operation of the NSSS.

4. On-Site Training (6 months), includes one month of assistance from Combustion Engineering for the review training of personnel for the AEC Cold Senior Reactor License examinations. A comprehensive written and oral examination will be administered to each trainee to verify that he has obtained the necessary knowledge to take the AEC examinations.

5. Other Training Assistance. Combustion Engineering will provide additional training assistance to include the following items, if desired:

   a. Interviewing and examining trainees (40 or less) to assist in selection.

   b. Physics and thermal-hydraulics work experience at Combustion Engineering for two engineers for 3 months.

   c. Providing a guide to assist the customer in training the reactor operators in preparing for the Hot License examinations on the plant.

   d. Specialist training for fuel management, health physicists, instrumentation technicians, and maintenance personnel.

For more information, contact: Manager, Project Services
Nuclear Power Department
Combustion Engineering
Windsor, Connecticut 06095

C. General Electric Company offers a six-part nuclear power plant training program.

Part 1. Observation at an Operating Reactor (12-16 weeks) is recommended to provide selected personnel with some background and familiarity with fundamentals of nuclear power and radiation protection techniques. While responsibility for arranging for this training rests with the purchaser of the G.E. nuclear steam supply system, G.E. will assist if requested.

Part 2. Basic Nuclear Course (12 weeks) is to be an introduction to nuclear phenomena as they apply to reactor technology and is not required of persons with previous nuclear experience. The course is given at the G.E. Vallecitos Nuclear Center near Pleasanton, California. Similar courses can be obtained from universities listed elsewhere in this release.

Part 3. BWR Technology Course (4 weeks), given at the APED, San Jose, California, deals with the specific features of the BSR plant being purchased as well as with general considerations of reactor system design.

Part 4. BWR Nuclear Power Plant Operator Training (12 weeks), given at the G.E. Nuclear Power Plant Training Center near Morris, Illinois, is to prepare selected personnel for operation of the reactor and to meet the requirements for applying for the USAEC reactor operator license examination prior to initial fuel loading. This period of training also includes observation of operation of the Dresden Station units.

Part 5. Specialist Training, arranged according to the specialties required to efficiently operate a BWR, is given either at the Atomic Power Equipment Department (APED), San Jose, or at the Vallecitos Nuclear Center.

a. Station Fuel Management Course (12 weeks) is to provide technical and first level supervision personnel with information and methods needed for efficient fuel management.

   The last four sessions cover areas which extend beyond individual plant and which consequently should interest an audience not intimately involved in the operation of a nuclear power station. Attendance of additional utility personnel at these sessions can be arranged.

b. Control and Instrumentation Course (12 weeks) deals with the nuclear instrumentation that will be supplied with the plant purchased and is primarily designed for engineers rather than technicians.

c. Radio-Chemistry Course (12 weeks). On-the-job training directed toward the plant chemist to give specific work experience, building upon the knowledge which the attendee already has.

d. Radiation Protection Course (12 weeks) is directed toward the plant health physicist and is to acquaint the attendee with all aspects of the radiation protection field of importance to his nuclear power station.

Part 6. On-Site Training (about 12 months) This particular phase of the training is primarily the responsibility of the utility. G.E. training personnel will assist in the overall planning of this training, and G.E. startup engineers will assist, consistent with their duties. Those in the utility staff who participated in any of the G.E. courses previously described have a significant responsibility in planning and carrying out this phase of the training.

For more information, contact: Manager, Field Engineering
Mail Code 593
General Electric Company
San Jose, California 95125

D. Gulf General Atomic, Inc.

Offers all phases of nuclear operator training to prepare utility personnel to operate High Temperature Gas-Cooled Reactors (HTGR). The program is divided into five categories:

1. Basic nuclear indoctrination in sufficient depth to allow the trainee to assimilate and utilize all future training.

2. HTGR operational training with the objective of the trainees becoming Senior Licensed Operators or Licensed Operators on an operating HTGR plant.

3. HTGR technology training to provide prospective HTGR plant operators and selected engineers with detailed, operationally oriented information on the design, expected operating characteristics, and associated scientific technology related to their own plant.

4. On-site training, considered the most important part of the future operator's training, provides the necessary work experience for all personnel assigned to an HTGR plant and in addition maintains the formal training necessary for successful completion of AEC licensing.

5. Specialist training attended by selected individuals to be trained in support areas directly related to their positions in the plant staff including computer programming and maintenance, control and instrumentation, nuclear fuel management, health physics, and radio-chemistry.

In addition, Gulf General Atomic provides management training to provide a broad background related to nuclear power reactors. The course is aimed at individuals at the management level in utilities interested in building up a background in nuclear power. The knowledge gained will be valuable in preparing for nuclear power and judging comparative merits of nuclear proposals.

For more information, contact: Training Specialist
Gulf General Atomic, Inc.
P. O. Box 608
San Diego, California 92112

E. Westinghouse Co. offers a reactor operator training program to provide thorough pressurized water reactors knowledge, operating ability, and operating experience to nuclear power station personnel. The program is divided into four categories: Initial Reactor Operator Training; Replacement Operator Training; Proficiency Training; and Additional Training Programs and Services.

Part 1. Initial Reactor Operator Training designed for individuals with no nuclear experience. Intent: provide nuclear technology background and training in nuclear power plant operation. Operator training scheduled for 1971 or later based on use of simulator. Present programs use Waltz Mill Site and SNEC reactor, Saxton, Pennsylvania. The program consists of seven phases:

1. Fundamental Training and Reactor Operations for Senior Reactor Operators - conducted at the Westinghouse Nuclear Training Center, lasting approximately 12 weeks including use of a critical facility.

2. Fundamental and Initial Plant Systems and Operation Training for Reactor Operators - conducted at the customer's plant site and approximately 12 weeks in duration. This phase consists of fundamental training for Reactor Operator license applicants.

3. Westinghouse Atomic Power Division (WAPD) Lecture Series - held at WAPD Headquarters, Monroeville, Pennsylvania. Intended to provide information on the design and operation of systems and components of the specific plant the trainee will operate. This phase lasts approximately five weeks.

4. Observation Period at an operating PWR for Senior Reactor Operator license applicants.

5. Plant Systems and Operations - approximately 24 weeks of training at the customer's plant site. The lessons presented by the Westinghouse training coordinator and the customer's key personnel cover all systems, components, and operating and safety procedures to be incorporated in the customer's plant.

6. Simulator Training beginning 1971, initially in conjunction with other phases of the initial reactor operator training program for qualifying Senior Reactor Operators for fuel loading and initial startup of their reactors upon successful completion of USAEC

licensing examinations.

7. Examination Preparation and USAEC Examination - a comprehensive four week review at the customer's plant site in preparation for USAEC licensing examinations.

Part 2. Replacement Operator Training Program - tailored to individual specific needs and covers appropriate phases of initial reactor operator training program.

Part 3. Retraining Program - simulator retraining at a Westinghouse Nuclear Training Center or customer owned simulator. Provides retraining to meet the requirements of individual operators or groups of operators, enabling them to properly recognize and react to an emergency as well as safely perform scheduled operations such as shutdowns and startups.

Part 4. Additional Training and Services - specific additional nuclear training programs are as follows:

a. Nuclear and PWR Technology
b. Special Design Lecture Series
c. Specialist Training
d. Instrumentation Technician Training
e. Health Physics Technician Training
f. Basic Physics and Mathematics Refreshers

Westinghouse will also arrange other specialized training, supply manuals, lesson plans, computer software programs, and other special training materials and aptitude testing.

For more information, contact: Manager Operator Training
Westinghouse Electric Corporation
Atomic Power Division
Penn Center Site, Box 355
Pittsburgh, Pennsylvania 15230

III. CONSULTANTS

A. Douglas United Nuclear, Inc.

Offers an integrated spectrum of services to electrical utilities and the general nuclear industry through its Nuclear Systems Consultants Division. In addition to the training services described below, specialized training programs including health physics, consultation, radiation exposure reduction and maintenance management orientation are also offered.

Management Seminar on Nuclear Power offers utility top and middle management a rapid, thorough orientation on management problems associated with going nuclear. Formal and informal sessions will be led by Douglas United Nuclear managers and senior technical specialists who have been associated with the process development, design, construction and operation of Hanford reactors including the world's largest operating power reactor, N Reactor. Sessions cover five days at Richland, Washington; topics of most critical concern to top management concentrated in first two days. The material covered during this period can be given separately at a location selected by the utility.

Fundamentals for Nuclear Power Operators provides basic instruction in mathematics, science, reactor technology, and radiation protection needed by operators and senior operators. Eight-week course prepares students for subsequent applied training. Conducted at utility-selected site.

Elements of an Engineered Maintenance System is intended for the maintenance staff charged with establishing or upgrading a nuclear facility maintenance program. The course will be presented by managers and engineers who have developed a highly practical and effective maintenance program for the Hanford production reactors. This training program can be presented at a site convenient to the utility or utilities in attendance. The six-part course emphasizes the need for a total integrated maintenance program - ranging from establishment of detailed maintenance procedures to computer analysis of maintenance test data - to assure safe and efficient facility utilization. The course length varies from one to three weeks depending upon the subjects selected.

For more information, contact: Douglas United Nuclear, Inc.
Nuclear Systems Consultants
1201 Jadwin Avenue, Swuite 205
Richland, Washington 99352

B. General Physics Corporation

Functions primarily as educational consultants (compares the training package offered by the reactor vendor with the backgrounds of the utility's personnel to recommend personalized supplementary training) but provides or arranges for Phase-1 and -1a operation training and provides a refresher prior to operator licensing. Provides management orientation, fuel management, and safety courses; arranges for other specialty courses.

For more information, contact: President
General Physics Corporation
687 Baltimore National Pike
Ellicott City, Maryland 21043

C. National Nuclear Corporation

Nuclear Training Courses offered jointly by National Nuclear Corporation and Stanford University.

General Background Course for management, administrative, and professional staff personnel of utilities. Its objective is to provide the participants with a basic understanding of nuclear power technology and operation, enabling them to utilize this knowledge in the performance of their own duties. (5 day course)

Nuclear Technology Course for utility engineering personnel. Covers the basic principles of nuclear reactor systems and engineering with a distinct emphasis on practical applications to power systems. (6 week course)

Operator Training Course for individuals who will be expected to qualify as reactor operators with emphasis on the actual mechanics of reactor operation. Includes training in operation of pool-type reactor. The course is designed to fit with detailed operator training as provided by reactor manufacturers. (4 week course)

Steam Systems Course to present a synthesis of thermodynamics, fluid mechanics, and heat transfer, as applied to steam generation systems. (4 week course)

Fuel Management Course for experienced utility engineers. Includes details of the nuclear fuel cycle, computer techniques, safeguards, and financial aspects. (4 week course)

For more information, contact: President
National Nuclear Corporation
701 Welch Road
Palo Alto, California 94304

D. Nuclear Associates International Corporation

Provides a fuel management staff training program based on the concept of working with the utilities to develop experienced nuclear engineers armed with the analytical methods and computer codes necessary to do

accurately and efficiently the performance monitoring and analysis required by each power reactor. The backbone of the system is the computer. This computerized system will cover functions from processing and logging reactor data to performing core physics calculations to economic calculations.

NAI has two basic approaches to technical education. The first approach to training of utility personnel is to have them actually working with NAI to set up the analytical model of the utility's reactors. Utility personnel are thereby trained in the use of nuclear codes, analytical methods, and assumptions used.

The second approach is to present seminars on the NAI nuclear engineering system to the utility industry.

For more information, contact: President
Nuclear Associates International Corp.
12601 Twinbrook Parkway
Rockville, Maryland 20852

E. Nuclear Management, Inc.

Conducts fuel management training in conjunction with an actual fuel management program in which specific codes, procedures, and experience are developed within the utility's staff. Contracts for three to five years training are written. During this period the utility's staff is trained, codes developed, and procedures established so that the utility's personnel can continue the Fuel Management Program independently.

For more information, contact: President
Nuclear Management, Inc.
402 Northwestern Avenue
West Lafayette, Indiana 47906

F. NUS Corporation

Nuclear Power Familiarization Course to acquaint utility management personnel with the concepts and problems unique to a nuclear power plant. This is a two-day course, but a five-day version is also given.

Introduction to Nuclear Power to instruct engineering personnel in the fundamental engineering, economic, and operational aspects of nuclear power generation. The course consists of 36 four-hour lectures, including scheduled problem sessions and review and discussion time. It is given on part-time basis at utility headquarters. A four-week summer session is given in July at NUS Headquarters in Rockville, Maryland.

Nuclear Power Preparatory Training. This sixteen-week course is to provide engineers, shift supervisors, and control operators with a thorough understanding of the basic principles, characteristics, and unique features of a nuclear steam supply system. This program is considered "basic training" for personnel who are to receive additional system design training from the reactor manufacturer, and plant or simulator training. If desired, research

reactor training can be incorporated into the Nuclear Power Preparatory Training program utilizing university or industrial reactor facilities.

Workshops, Short Courses, and Seminars are offered on:

- Advanced Fuel Management
- Protection System Reliability Analysis
- Nuclear Fuel Management
- Core Analysis
- Nuclear Plant Liquids

NUS Operational Support Services include:

- AEC license exam preparation
- Startup assistance and operations support
- Health physics training and services
- Specialized training in radiation safety, chemistry, fuel management, and instrumentation
- Replacement personnel training
- Refresher training and requalification
- Fuel management
- Pollution evaluation and abatement

For further information, contact: NUS Corporation
2351 Research Boulevard
Rockville, Maryland 20852

G. S. M. Stoller Associates

Fuel Cycle Seminar for Investment and Financial Community offers a course on short-term growth forecasts, a closeup look at the uranium supply demand picture, fuel procurement trends, financing requirements and trends in fuel technology.

For further information, contact: S. M. Stoller Associates
201 Park Avenue, South
New York, New York 10003

IV. PROGRAMS AT UTILITIES

The following utilities have expressed a willingness to make available on-shift experience if not in conflict with their own training programs.

1. Commonwealth Edison Company will make the Dresden Station, near Morris, Illinois, available on an observation basis for use in connection with the boiling water reactor operator training programs offered by the General Electric Company.

For more information contact: General Electric Company
Atomic Power Equipment Department
175 Curtner Avenue
San Jose, California 95125

2. Consolidated Edison Company of New York, Inc. will consider private arrangements with other utilities for the use of Indian Point Unit #1 in New York for training operators, subject to the limitations of their own operating requirements and training needs.

For more information contact: Consolidated Edison Company of New York, Inc.
4 Irving Place
New York, New York 10003

3. Consumers Power Corporation will consider requests from utilities and other organizations for the provision of work experience training at the Big Rock Point Plant, near Monroe, Michigan, subject to the plant operating requirements and the company's requirement for the training and experience of its own personnel. A statement of policy is available from the company on request.

For more information contact: Consumers Power Company
212 West Michigan Avenue
Jackson, Michigan 49201

4. Pacific Gas and Electric Company expects to continue to provide nuclear orientation training at the Humboldt Bay Power Plant near Eureka, California, for its own personnel and for a limited number from other companies. About six trainees can be accommodated at one time on a three-shift basis for orientation periods of eight to ten weeks.

For more information contact: Pacific Gas and Electric Company
245 Market Street
San Francisco, California 94160

5. Yankee Atomic Electric Company will consider informal arrangements with other utilities for the accommodation at the Yankee plant near Rowe, Massachusetts, for New England nuclear plants and subject to minimum disruption of normal plant operation.

For more information contact: Yankee Atomic Electric Company
441 Stuart Street
Boston, Massachusetts 02116

V. FEDERAL AGENCIES

A. AEC Sites

1. Since establishment of the AEC work experience program in 1957, more than 365 US industry representatives have participated. This is a flexible program available at certain AEC sites. It is not a standard course and is intended to supplement, if needed, existing training courses in industry and universities. Past programs have ranged from on-shift experience of entire initial operating crews for power reactors through to individual experience for a Health Physics technician or fuel-cycle specialist.

AEC sites include the Hanford (Washington) production reactors, Argonne National Laboratory (Illinois), Oak Ridge National Laboratory (Tennessee), National Reactor Testing Station (Idaho), Brookhaven National Laboratory (New York) and Savannah River Laboratories (South Carolina).

For more information, contact: Director, Division of Industrial Participation
US Atomic Energy Commission
Washington, D. C. 20545

2. The AEC provides four 3-day seminars, annually, on "Medical Planning and Care of Radiation Accidents" as part of its immediate goal to have a trained cadre of approximately 300 physicians available strategically, distributively and geographically. These sessions are limited to 40 physicians each and are all oversubscribed through 1970. The seminars are designed for private physicians affiliated with nuclear power plants and other licensed nuclear facilities and for physicians from local hospitals which have agreed to assist where possible in the event of a radiation accident.

At these seminars, recognized authorities conduct sessions in such areas as the diagnosis and general emergency treatment of acute radiation illness; general care of acute radiation injury; general care of persons with internal alpha contamination; the use of chelating agents (which chemically absorb such radioactive materials as plutonium); information on admitting contaminated patients to hospitals; and radiation controls to minimize contamination of hospitals, personnel and vehicles.

The AEC also provides guidance to organizations which wish to give courses in fighting fires involving radioactive materials.

For more information contact: Director
Division of Operational Safety
US Atomic Energy Commission
Washington, D. C. 20545

B. Other Government Organizations

1. National Center for Radiological Health provides a number of 1— and 2-week courses at various regional centers. Of particular interest to utilities are the following:

Basic Radiological Health - This 2-weeks course provides professional health personnel with the basic technical knowledge essential to radiological health work. It or equivalent training is prerequisite to most of the other courses offered. The course covers the basic nuclear physics necessary for an understanding of the technical aspects of radiological health problems in public health. It discusses in detail the major sources of radiation exposure, modes of radiation injury, and quantitative units and terminology used in this field. Existing standards for radiation protection are discussed. In the evaluation of specific problems, emphasis is placed on the use, operation, and calibration of laboratory and field-survey instruments. Approximately one-third of the scheduled time is devoted to problem and laboratory sessions.

Radiological Health for Nurses - This 1-week course provides nurses with a knowledge of the fundamentals of radiation, its biological effects, medical uses and nursing implications, and the principles of radiation protection. It assumes no previous knowledge of radiological health. Included in the course are laboratory sessions on patient protection, patient monitoring, handling of radioactive materials, and use of personnel survey and laboratory counting instruments.

Measurement of Airborne Radioactivity - This 1-week course is intended for professional personnel responsible for measuring radioactive contaminants in air. It enables the trainee to collect a representative sample and perform the analysis necessary to determine the activity concentration of radionuclides in air, and evaluate environmental and occupational conditions. Trainees receive instruction in the basic physics of air, the fundamentals of gas and aerosol behavior, instrumentation used in sampling gases and aerosols, analysis for gross radioactivity and for specific radionuclides, and the health implications of airborne radioacitivity. Problem sessions and laboratory exercises supplement the lectures. For those needing on-the-job training, arrangements can be made for several days of bench training immediately following the course. Laboratory experience, individually planned for the trainee, can be provided in such areas as: collection and identification of fission products from air samples, fabrication of organic-soluble filters and filter radioactivity standards, autoradiography, and fallout particle isolation. In addition, field trips may be arranged to local reactors and laboratories.

Occupational Radiation Protection - This 2-weeks course is intended for industrial hygienists, health physicists, and other professional personnel concerned with in-plant radiological health problems. Major emphasis is placed on evaluation of external and internal exposure to radionuclides and methods for protection against these hazards. Neutron sources and machine-produced radiation, exclusive of medical X-rays, are considered as well as special problems associated with nuclear emergencies. Medical X-ray protection is of such importance, from the operator and patient-exposure viewpoint, that a separate course is devoted exclusively to it. Approximately one-third of the course is devoted to laboratory exercises.

Reactor Safety and Hazards Evaluation - This 2-weeks course is designed to provide an appreciation of the public health aspects of nuclear facility operation to personnel of public health agencies, nuclear industries, and military reactor installations. Because of its advanced nature, a degree in science or engineering is necessary. Principal areas covered are: reactor fundamentals, engineered safeguards, design safety analysis, development of emergency plans, and environmental surveillance. Major emphasis will be given to power reactors of the pressurized-water and boiling-water types. Field trips will be made to selected reactors in the area. Trainees will have the opportunity to review and devise both on— and off-site emergency plans. Groups will discuss specific problems.

Chemical Analysis of Environmental Radionuclides - This 2-weeks course is designed for professional laboratory personnel who measure radionuclides in milk, foods, and water by radiochemical analysis. The principal objectives are to enable the trainee to: (1) conduct representative procedures for the determination of radionuclides of environmental significance; (2) initiate and develop a quality control program to insure the precision and accuracy of analytical results; and (3) evaluate radiochemical procedures as to their methodology and applicability to individual situations. Instruction is given by lectures, demonstrations, and laboratory sessions (the last comprising approximately half the course).

Management of Radiation Accidents - This 1-week course provides medical, engineering, and scientific personnel with knowledge of the potential hazards arising from accidents involving radiation. It also gives guidance for the management of these accidents. Major attention is devoted to potential sources and types of accidents, preplanning, first-stage management and follow-up, and public relations. Selected accidents are reviewed in detail. Class and panel discussions enable the trainee to discuss specific problems with other class members, the training staff, and consultants. Field exercises may be scheduled, and trainees should bring clothing suitable for such activities.

Operational Aspects of Radiation Surveillance - This 2-weeks course is intended for engineers, scientists, and other professional personnel responsible for or interested in planning and conducting environmental radiation surveillance programs. Trainees obtain technical information and techniques necessary to perform the following procedures in a surveillance program: establish practical objectives; plan, organize and conduct a sampling program; interpret public health significance of surveillance data; and determine feasible control actions. The course includes lectures and demonstration and problem sessions covering the movement of radionuclides through the environment from the source of emission to the sampling point.

Training continues with considerations of air, food, and water sampling. Surveillance data is evaluated in terms of public health significance and public health action as outlined in reports of the Federal Radiation Council. All these subjects are correlated with the planning and conduct of surveillance programs. Analysis for radionuclides is covered only in relation to its effect on the selection of sampling procedures.

Radionuclide Analysis by Gamma Spectroscopy - This 2-weeks course is intended for professional personnel who measure environmental radioactivity. It enables the trainees to evaluate the performance of a gamma spectrometer and perform qualitative and quantitative analysis of environmental samples by gamma spectroscopy. The course begins with instruction in the theory and operation of the gamma spectrometer. Presented next are the considerations necessary for the selection of a spectrometer and the procedures for evaluating its performance. Then follows a consideration of spectral analysis methods, including hand calculation and computer methods. During the course, a spectrometer is calibrated, and a 4 x 4 matrix system for milk analysis is developed. Extracurricular instruction can be made available for orientation to an analyzer system.

VI. UNIVERSITY INTEREST IN COOPERATIVE UTILITY PROGRAMS

University of California at Berkeley

This university has a 1 MW TRIGA III Reactor. The Department of Nuclear Engineering had developed a utility training program that would be given under the auspices of the University of California Extension. The program consists of three parts: (1) a course for senior management engineers designed to familiarize them with the basic technology of nuclear power generation; (2) a course for start-up engineers designed to prepare them for AEC Reactor Operator's License Exams; and (3) a course in nuclear instrumentation for plant technicians designed for people with no academic background.

Contact: Dr. Hans Mark, Chairman
Nuclear Engineering Department
University of California
Berkeley, California 94720

University of California at Los Angeles

This university has a 100 KW Argonaut reactor. Starting in the fall of 1968, a formal course for reactor operator training is being given through the University of California Extension, leading to the taking of an AEC reactor operator license for the university reactor. The university is interested in collaboration with utilities and other organizations in providing both short and long range training programs. Plans are being developed for a 2 or 3 week short course next summer for utility administrators and executives.

Contact: Dr. Craig B. Smith
Dept. of Engineering, University of California
Los Angeles, California 90024

Clarkson College of Technology

This institution does not have any special nuclear training courses outside their normal graduate level offerings in nuclear science and engineering. However, they are definitely interested in collaborating with utilities or other organizations in the training of nuclear-oriented personnel. The power engineering program at Clarkson is sponsored by the Niagara Mohawk Power Corporation and provides fellowships, faculty support, equipment funds, and other support for M.S. and Ph.D. students interested in major study and research in some area of power engineering.

Contact: Dr. Thomas J. Ward, Associate Professor
Department of Chemical Engineering
Clarkson College of Technology
Potsdam, New York 13676

Colorado State University

At the present time this university has an AGN 201 "training reactor" and is exploring the possibility of acquiring a research reactor. The university has been providing specialized training for Public Service Company of Colorado and is interested in broadening this effort to include other utilities, with some emphasis upon the Rocky Mountain States.

Contact: Dr. Hilding G. Olson
Director of Nuclear Engineering Research
Colorado State University
Fort Collins, Colorado 80521

University of Florida

This university has a 100 KW Argonaut reactor. The university has had cooperative programs with the Florida Power and Light Company, and with the Florida Power Corporation. These programs involved teaching by faculty members at both Florida Power and Light and at the university, as well as a series of experiments utilizing the laboratory facilities and the nuclear reactor. At the present time the university is encouraging faculty members to work with utilities on a consulting basis, but each such request is reviewed on its own merits. In addition to this cooperative work in retraining of utility employees, the university has a program in "Electric Energy Engineering" under the Department of Electrical Engineering, leading to Bachelor's, Master's and Doctorate degrees. Courses available include offerings in the Departments of Nuclear Engineering Sciences, Mechanical Engineering, and Industrial and Systems Engineering. Four Florida utilities help finance this effort.

Contact: Dr. Ronald Dalton
Department of Nuclear Engineering Sciences
University of Florida
Gainesville, Florida 32601

University of Maryland

This university has a 10 KW pool type reactor used for courses and research work. The university has cooperated with Nuclear Utility Services in the latter's overall utility consulting and training program, and is interested in developing cooperative programs with utilities.

Contact: Dr. J. M. Marchello, Chairman
Department of Chemical Engineering
University of Maryland
College Park, Maryland 20742

Massachusetts Institute of Technology

This university has a 5 MW heavy water research reactor. At the present time, MIT's major approach in preparing manpower for utilities is through their academic programs in nuclear engineering and related subjects. About 7 graduate students are engaged in thesis research of interest to utilities. Their annual summer programs in Reactor Safety attract many personnel from utilities interested in developing nuclear power capabilities. In addition, the MIT Center for Advanced Engineering Study makes possible individually tailored programs of instruction for key technical personnel who wish to return to MIT for a year in order to obtain up-to-date instruction in some new technical field.

Contact: Dr. Manson Benedict, Chairman
Department of Nuclear Engineering
Massachusetts Institute of Technology
Cambridge, Massachusetts 02139

University of Michigan

The university operates a 2 MW research reactor. A summer program in Nuclear Power Engineering given for the past 6 years has served a large number of engineers from utilities. The Department of Nuclear Engineering has also set up special training programs for a number of industries and utilities. At the present time plans are being made to organize a program for operator training in cooperation with a local junior college. The department's regular academic program provides for specialization in nuclear power engineering at both undergraduate and graduate level.

Contact: Professor William Kerr, Chairman
Department of Nuclear Engineering
University of Michigan, North Campus
Ann Arbor, Michigan 48105

New Mexico State University

The university offers a program to emphasize electric utility management training of engineers in electrical power systems and engineering economy. The San Diego Gas & Electric Co. and 12 other utilities in the Southwest and General Electric and Westinghouse Foundations have underwritten an initial $114,000 3-year program and 5 graduate fellowships of about $4,000 each.

Contact: Professor William Kersting
Department of Electrical Engineering
New Mexico State University
Las Cruces, New Mexico 88001

North Carolina State University

The university has a 10 KW pool reactor and is attempting to acquire a more high powered research reactor. During the academic year 1967-68, the Nuclear Engineering Department, in cooperation with the Duke Power Company and the Virginia Electric Power Company, developed and implemented a

program for providing nuclear engineering training for engineers experienced in the operation of conventional power plants. These students were enrolled in the regular graduate level programs, leading toward the degree of Nuclear Engineer. It is intended that this mutually beneficial program will be continued and expanded in the future. The Department is also interested in the development of cooperative programs for nuclear technicians and nuclear power plant operations, with utilities or with a reactor vendor.

Contact: Dr. Raymond Murray, Chairman
Department of Nuclear Engineering
North Carolina State University
Box 5636
Raleigh, North Carolina 27607

Oregon State University

This university has both an AGN 201 Training Reactor and a 250 KW TRIGA III Research Reactor. The university provided a six-month short course "Introduction to Nuclear Technology" to approximately 90 employees of the Portland General Electric Company on a 3-hour lecture per week basis. Discussions are underway for additional courses for several interested parties in the Pacific Northwest.

Contact: Dr. C. H. Wang
Radiation Center
Oregon State University
Corvallis, Oregon 97331

Pennsylvania State University

This university has a 1 MW TRIGA III Research Reactor. The Nuclear Engineering Department has designed a "Nuclear Power Plant Supervisors Training Program" and a "Reactor Operators Training Program" for employees of utilities who will need to acquire senior reactor operators or reactor operators licenses, respectively. As of June 1968 over 95 students enrolled in these programs have become AEC-licensed operators and senior operators, plus an additional attendance of 30 trainees from foreign countries. Courses are 12 weeks in length, and have varied in size from 4 to 20, with 10 being considered optimum.

Contact: Dr. Warren F. Witzig, Head
Nuclear Engineering Department
Pennsylvania State University
University Park, Pennsylvania 16802

University of Puerto Rico

The Puerto Rico Nuclear Center, operated by the University for the Atomic Energy Commission, has an L-77 Teaching Reactor and a pool-type research reactor operating at 1 MW. The Center has trained 2 reactor supervisors for Colombia, 4 reactor operators for PRNC, 12 reactor operators for BONUS, as well as 3 members of the BONUS start-up team. A three-month full-time course in Reactor Supervisor Training and a six-month full-time course in Reactor Operator Training are currently inoperative but can be reactivated

in short notice.

Contact: Dr. Henry Gomberg, Director
Puerto Rico Nuclear Center
Caparra Heights Station
San Juan, Puerto Rico 00935

Purdue University

This university has a 10 KW pool-type reactor. About five years ago, within the Engineering Experiment Station a "Purdue Energy Research and Education Center (PEREC)" was established to help meet the needs of the electric utility industry. Twelve different utility companies have been contributing to research and education projects, with major portion of the work involving computer applications to electric power network analysis. Most of this work has been through the Schools of Electrical and Mechanical Engineering. The Nuclear Engineering Department has primarily worked on nuclear fuel management directed toward the education of utility employees, although one code, CINCAS, has been jointly developed for use in accounting for nuclear fuel. The university has given a "Nuclear Fuel Management" course for middle management at the Commonwealth Edison Company in Chicago, a condensed similar program on its own campus in the summer, and is developing an "Advanced Seminar in Nuclear Fuel Management" with Commonwealth Edison.

Contact: Dr. Philip N. Powers
Department of Nuclear Engineering
Purdue University
Lafayette, Indiana 47907

Rensselaer Polytechnic Institute

This university has a critical facility. Nuclear reactor operator training courses and continuing studies programs for engineers are available at Rensselaer Polytechnic Institute; these are supported both by the nuclear engineering faculty and by members of other departments who have had relevant experience in industry and national laboratories. An example is the operator training course provided in the summer and fall of 1967 for a group of twenty-two utility operators and engineers seeking senior operators licenses; this course covers necessary fundamentals including loading, operation and experiments on the Rensselaer critical facility, as well as lectures and problem sessions covering health physics, mathematics, nuclear physics, reactor engineering, heat transfer, et al. The critical facility is the chief laboratory tool; it is supplemented by a subcritical reactor and by nuclear instrumentation used to familiarize personnel with principles of operation of reactor instruments and controls and health physics monitors. The continuing studies program includes technical survey courses and business oriented studies for management personnel as well as professional courses for engineers.

Contact: Dr. Max L. Yeater
Department of Nuclear Engineering & Science
Rensselaer Polytechnic Institute
Troy, New York 12181

Stanford University

This university has a 10 KW pool-type reactor. The university is engaged in a discussion with many West Coast utilities about the development of a series of courses for utility personnel to be presented in conjunction with the National Nuclear Corporation. Personnel of the company has had considerable experience in nuclear power station design and operation. Hence the joint effort is intended to provide a combination of applied and academic programs, either at the utility or at the university, depending upon the specific subjects. Developing concepts include: General Background Course for non-technical management; Nuclear Technology for engineering personnel; Operator Training; Fuel Management and Steam Systems.

Contact: Dr. T. J. Connolly, Director
Nuclear Engineering Division
Stanford University
Stanford, California 94305

Texas A & M University

This university has an AGN 201 teaching reactor and a 1 MW pool-type reactor. The Department of Nuclear Engineering has provided training programs for crew members of the nuclear ship SAVANNAH and maintains an interest in continuing that program and in providing assistance to utilities in retraining of their staffs for nuclear power if mutually complementary programs can be developed.

Contact: Dr. R. G. Cochran, Head
Nuclear Engineering Department
Texas A & M University
College Station, Texas 77843

University of Virginia

This university has a 1 MW swimming pool reactor used for student courses and research. Engineers from utilities are welcome during the academic year to take a program of graduate courses arranged specifically for them. This program will include reactor theory, power plant engineering, reactor safety, health physics, shielding, and operations training on the reactor. Special summer courses for non-engineering personnel in reactor operations and health physics may be given subject to demand.

Contact: Dr. Lawrence Meem, Jr.
Department of Nuclear Engineering
University of Virginia
Charlottesville, Virginia 22901

University of Washington

This university has a 100 KW Argonaut research and teaching reactor. Special courses in the reactor area started with a group of 100 Naval officers and engineers at the Puget Sound Naval Shipyard. Lockheed Shipbuilding and Drydock Company also arranged for special training. The university will be working with Puget Sound Power and Light Company to

develop a series of special courses to be given on their premises to supplement courses taken by their employees in the regular nuclear engineering academic program.

Contact: Dr. A. L. Babb, Chairman
Nuclear Reactor Group
College of Engineering
University of Washington
303 Benson Hall
Seattle, Washington 98105

Western New York Nuclear Research Center (a subsidiary of State University of New York at Buffalo)

This Center includes a 2 MW Pulstar research reactor. WNYRC provided training programs of 12 weeks duration for 20 individuals for the Nine Mile Plant of Niagara Mohawk. Discussions have been held with various utilities as to the potential for establishing a critical facility for reactor operator training as the Center maintains an interest in providing special training for utility personnel. Discussions are also underway relative to the development of evening nuclear engineering programs for B.S. engineering personnel currently employed by utilities.

Contact: Mr. William Hall
Western New York Nuclear Research Center, Inc.
Power Drive
Buffalo, New York 14214

University of Wisconsin

This university has a 1 MW pool-type research reactor. In the fall of 1967 they held a session on "Training for Nuclear Power Plant Operation" attended by utilities, reactor vendors, consulting firms and a few other educational institutions interested in utility staffing and training problems. An "Introductory Course in Nuclear Power Plants" has been given in Green Bay for people from Wisconsin Public Service Corporation and the Wisconsin-Michigan Power Company. The university is interested in cooperating with utilities in operator training primarily in nuclear and reactor aspects and in safety and radiation monitoring.

Contact: Dr. Max Carbon, Chairman
Department of Nuclear Engineering
University of Wisconsin
1513 University Avenue
Madison, Wisconsin 53705

Virginia Polytechnic Institute

This university is currently conducting a 36-week basic nuclear program for Arkansas Power and Light under subcontract with the Babcock and Wilcox Company. A new adult education center on campus provides lodging, meals and classrooms under one roof. Virginia Polytechnic Institute has a 100 KW Argonaut reactor with a new Bailey Model-780 control console. All university facilities are available to utilities throughout the year through the Division of Extension.

Contact: Dr. Andrew Robeson
Advisor
Nuclear Science and Engineering
Virginia Polytechnic Institute
Blacksburg, Virginia 24061

VII. UNIVERSITIES WITH POWER SYSTEMS ENGINEERING PROGRAMS

PARTIAL LIST OF SCHOOLS WITH STIPULATED PROGRAMS IN POWER SYSTEMS ENGINEERING

Schools	Type of Program
1. University of Akron	Masters degree program.
2. Clarkson College of Technology	Professorships and fellowships for power program supported by Niagara Mohawk Power Company. B.S., M.S., and Ph.D. options in power systems.
3. University of Florida	B.S., M.S., and Ph.D. programs and research supported by Florida investor-owned electric utilities.
4. Illinois Institute of Technology	Professorship for graduate program in power systems supported by five companies.
5. Iowa State University	Undergraduate courses in power and graduate programs in utilities engineering and electric power, including research supported by affiliates.
6. University of Maine	Postgraduate program with local utility support.
7. Massachusetts Institute of Technology	A Power Systems Engineering Group has been established under the direction of the Philip Sporn Professor of Energy Processing. Students and faculty, representing different engineering disciplines, work on problems associated with the generation and distribution of electric power.
8. Newark College of Engineering	Masters degree program.

Schools	Type of Program
9. New Mexico State University	The San Diego Gas and Electric Company, 12 other Southwest utilities, and General Electric and Westinghouse Foundations have underwritten an initial three-year program to emphasize electric utility management training for engineers in electrical power systems and engineering economy.
10. Northeastern University	Five-year B.S., six-year M.S. program supported by 23 utilities and three manufacturers.
11. Ohio State University	Ten graduate fellowships supported by seven Ohio utilities.
12. Oregon State University	Chair in nuclear engineering supported by Eugene Water & Electric Board, Pacific Power & Light Co., and Portland General Electric Co.
13. University of Oklahoma	Professorship supported by Oklahoma Gas and Electric Company.
14. Purdue University	Purdue Energy Research and Education Center with graduate program in power and support by electric utilities.
15. Rensselaer Polytechnic Institute	Professorships and fellowships supported by electric utilities and other companies.
16. Texas A & M	Research and graduate program supported by Texas electric utilities.
17. Tulane University	Electric power laboratory with local electric utility encouragement.
18. Virginia Polytechnic Institute	Electric energy research program for masters and doctoral candidates supported by Appalachian Power, Kentucky Power, Potomac Edison, Potomac Electric Power and Vepco.
19. University of Wisconsin	Professorship in power including research and graduate program, supported by Wisconsin electric utilities.

VIII. UNIVERSITIES WITH SHORT COURSES

Instructions pertinent to utility operation of nuclear plants may be either in the form of special short courses and seminars scheduled according to demand (usually in the summer) or as regularly offered courses as part of a curriculum.

No attempt has been made to list every nuclearly oriented course or university which has a reactor, or to specifically ask each university if it wishes listing. However, all replies have been included from a questionnaire sent in February 1968 to those universities participating in the AEC Special Nuclear Science and Engineering Fellowship Program. Also included were replies to specific inquiries later made of those universities with nuclear engineering departments known to be active in the general area of special cooperation with the electric utility industry. A more comprehensive listing of nuclearly oriented educational programs and facilities in nuclear science and engineering may be obtained by writing the Oak Ridge Associated Universities, P. O. Box 117, Oak Ridge, Tennessee 39830.

A. Colorado State University

Provides five 22-day Phase-I type of training programs for engineers employed by Public Service Co. of Colorado for the Ft. St. Vrain High Temperature Gas Cooled Reactor program. Participates in USPHS traineeship program in radiation health. Planning M.S. degree program in Radiation Protection as a joint effort of the Divisions of Radiology, Radiation Biology, and Mechanical Engineering.

For more information, contact: Head, Dept. of Mechanical Engineering
Colorado State University
Fort Collins, Colorado 80521

B. Florida, University of

Has provided staff training for Florida Power and Light Co. (Turkey Point PWR), Florida Power Corp. (Crystal River PWR), and Tampa Electric Co.

B.S., M.S., and Ph.D. programs in nuclear engineering have produced 52 graduates.

For more information, contact: Dean of Engineering
University of Florida
Gainesville, Florida 32601

C. Maryland, University of

Is interested in developing reactor trainee programs with utilities based on University of Maryland reactor and educational facilities.

M.S. and Ph.D. courses have produced 20 nuclear engineering graduates.

For more information, contact: Chairman, Chemical Eng. Dept.
University of Maryland
College Park, Maryland 20742

D. Michigan, University of

Provides special short courses as follows:

Boiling Heat Transfer and Multi-Phase Flow. The application of boiling heat transfer and multi-phase flow to the design of nuclear reactor, spacecraft and cryogenic systems will be presented. Applicants should have B.S. degree in either engineering or a physical science or the equivalent experience. (10 class days)

Nuclear Radiation Detection for Medical and Health Scientists. Intensive training in the fundamentals of detection and measurement or ionizing radiation, with emphasis on applications in the medical and health sciences. At least one year of college-level physics will be expected, but the use of calculus or detailed electronics analysis will be avoided. (10 class days)

Elements of Nuclear Power Reactor Engineering. Basic elements of nuclear engineering, especially reactor design and operation, and development of knowledge and skill in handling nuclear instrumentation and handling laboratory work. B.S. in engineering or equivalent background. Course will in general follow approximately the level of presentation in "Nuclear Reactor Engineering" by Glasstone and Sesonske. (20 class days)

Radiation Effects in Semiconductors and Interaction Processes. This course will provide insight into the effects of nuclear and space radiations in semiconductors and their effects upon semiconductor components. Applicants should have a bachelor's degree in either engineering or a physical science or the equivalent experience. A knowledge of differential equations will be assumed. (10 class days) B.S., M.S., and Ph.D. programs have produced 97 graduates.

For more information, contact: Head, Dept. of Nuclear Engineering
University of Michigan
Ann Arbor, Michigan 48105

E. Massachusetts Institute of Technology

Provides short courses on fast nuclear power reactor safety and water-cooled nuclear power reactor safety. Emphasis in both programs is placed on the safety considerations in:

Core design	Materials, metallurgy, fuels
Reactivity effect	Reactor criticality and startup
Fluid flow	Operator selection
Heat transfer	Training
Mechanical design	Safety instrumentation
Control	Reactor dynamics, transients
Containment	Fission product release and leakage
Engineering safeguards	Waste disposal

These programs are intended for degree-holding engineers and scientists who have some knowledge of nuclear reactor technology and who are or will be participating directly in the design, construction, operation, or regulatory safety review of large power reactors. The first week will be spent exclusively on fast reactors, the second week will consist of a set of lectures on topics relevant to both programs, and the third week will consider only water-cooled reactors. M.S. and Ph.D. courses have produced 185 nuclear engineering graduates.

For more information, contact: Head, Dept. of Nuclear Engineering
Massachusetts Institute of Technology
Cambridge, Massachusetts 02139

F. New York University

Provides a short course on nuclear fuel management. The course provides intense instruction in the fundamentals of nuclear fuel, the nuclear fuel cycle, fuel cost calculations, the use of computers in the fuel management function, spent fuel utilization, financing and accounting practices, and the interplay between reactor operation and fuel costs. The course is designed to provide engineering and management personnel with the basic knowledge necessary to reach economic and technical decisions associated with the planning, purchase, utilization and disposal of fuel for nuclear power plants. (5 day course)

Degrees are offered in nuclear engineering, nuclear physics, nuclear radiochemistry and radiological health.

For more information, contact: Department of Nuclear Engineering
School of Engineering and Science
New York University
University Heights, Bronx, New York 10453

G. North Carolina State University at Raleigh

Awards a Professional Degree in Nuclear Engineering for one year of work beyond the M.S. level; especially for utility personnel. Is planning a power reactor operator training program and a nuclear technician program with a regional technical institute.

B.S., M.S., and Ph.D. courses have produced 142 nuclear engineering graduates.

For more information, contact: Head, Dept. of Nuclear Engineering
North Carolina State University at Raleigh
Raleigh, North Carolina 27607

H. Ohio State University

Provides a short course on nuclear energy for the electric utilities. An introduction to the methods of nuclear conversion for those who are associated with the monitoring, op ration, management or safety of electrical generating plants. Emphasis will be on the last basic aspects of reactor theory and safety, startup and operations, reactor design considerations and economics. Participating lecturers are from Babcock and Wilcox, Tennessee Valley Authority, Westinghouse, Battelle Memorial Institute, and the College of Engineering, OSU. All students will have an opportunity to experience the OSU Nuclear Reactor startup and operating routine. (1 week course)

Participates in AEC special NSE fellowship program.

For more information, contact: Engineering Short Courses
Ohio State University
2070 Neil Avenue
Columbus, Ohio 43210

I. Oregon State University

Provided a short introductory nuclear power course for Portland General Electric Co. Is planning a 4-year nuclear power reactor technology technician training program.

For more information, contact: Director, Institute of Nuclear Science and Engineering
Oregon State University
Corvallis, Oregon 97331

J. Pennsylvania State University

Has provided initial staff orientation for engineers from Saxton Nuclear Engineering Corp. (Saxton PWR) and Philadelphia Electric Co. (Peach Bottom I HTGR), and Phase-1 training for Metropolitan Edison Power Co. (Three Mile Island, PWR) supervisors and operators. Reactor operator and reactor supervisor training programs were instituted in 1955 and 1967, and hazards analysis program in 1964, to provide year-long programs meshing with degree-type course work.

B.S., M.S., and Ph.D. courses have produced 56 nuclear engineering graduates.

Is planning a two-year associate degree course (in cooperation with another Pennsylvania school) in nuclear power reactor technology.

For more information, contact: Head, Dept. of Nuclear Engineering
Pennsylvania State University
University Park, Pennsylvania 16802

K. Puerto Rico, University of

Has provided Phase-1 and -1b training for operators and supervisors at BONUS BWR.

M.S. courses have produced 5 nuclear engineering graduates.

For more information, contact: Director, Division of Nuclear Engineering
University of Puerto Rico
Mayaguez, Puerto Rico 00708

L. Purdue University

Provides a three-week course in nuclear fuel management intended for both engineering and financial personnel in the electric utility industry. No previous training in nuclear engineering is required. The equivalent of this course was also taught by Purdue during 1966-67 and 1967-68 with most of the meetings being held in Chicago at the Commonwealth Edison Headquarters from 9:00 a.m. to 4:00 p.m. one day every other week from September to June. During 1968-69, the course meets usually on the Purdue campus, and the attendees over this three-year period have come from utilities, design firms, and an accounting firm.

M.S. and Ph.D. courses have produced 46 graduates in nuclear engineering.

For more information, contact: Head, Dept. of Nuclear Engineering
Purdue University
Lafayette, Indiana 47907

M. Renssalaer Polytechnic Institute

Provides the following

Programs for Personnel of Utilities and Reactor Manufacturers. A reactor operator training course and a nuclear technology program for engineers are two of the planned sequences for industrial personnel; these are summarized below along with the special courses which may be taken separately. These are suitable for classes which include representatives from more than one company, so that cooperation among companies is encouraged where necessary to make up a class of sufficient size, to be economically feasible; Rensselaer will assist in such coordination. Special classes for a particular industry or group will be arranged on request, including modifications or additions to courses.

Reactor Operator Training Course. To prepare operators, senior operators, supervisors, and engineers concerned with direct operational problems, in the fundamentals and basic operating skills required for licenses. Lecture topics and problems cover necessary mathematics, reactor physics, engineering principles, and radiological health physics at a level which is comprehensive but practical and geared to the needs and background of operators. Extensive laboratory work on a critical reactor includes individual startups as required by the AEC for preparatory licensing. Time: 10 to 15 weeks of full-time intensive effort.

Nuclear Technology Program for Engineers. A sequence of lecture and laboratory courses designed for engineers who will have plant, design or manufacturing responsibility for commercial reactor systems. Course material is taken both from the industrial course group listed below and from the more applied courses in the regular academic listing. The work is grouped

as follows: Basic atomic, nuclear and reactor physics; thermal, fluid and control problems; materials, radiation effects, chemical processing, fuel fabrication; economics and fuel management; reactor safeguards; environment safety, health physics; design practice and computer applications; reactor laboratory experiments and radiation monitoring; instrumentation and measurements laboratory; mathematics.

Special Courses for Industry. The following have been planned to meet the needs of several categories of industrial personnel. For those following a regular degree program it is expected that these will be available as electives:

1. Nuclear Reactor Design Fundamentals

   6 weeks on full-time basis or 15 weeks on part-time basis of Friday and Saturday class days each week.

2. Nuclear Power Plant Engineering Principles

3. Nuclear Energy Fundamentals

4. Fast Reactor Systems

5. Radiological Engineering

6. Reactor Safeguards

7. Nuclear Fuel Management

M.S. and Ph.D. courses have produced 46 nuclear engineering degrees.

Participates in AEC special NSE and HP fellowship programs.

For more information, contact: Head, Dept. of Nuclear Engineering
Renssalaer Polytechnic Institute
Troy, New York 12181

N. Stanford University

Stanford University and National Nuclear Corporation jointly offer a training program in nuclear technology for electric utility personnel. The program consists of several intensive courses of one to six weeks' duration for utility personnel on a variety of subjects, such as nuclear technology, power reactor operator pretraining, etc. Depending on the nature of the course, it will be presented at Stanford, making use of the University's reactor and laboratory facilities, or at the utility. These jointly offered courses include both the academic and industrial approaches in their content and presentation. The courses have been reviewed with utilities and incorporate their suggestions.

Course A. General Background (1 week at utility, or 1 day at a time)

Course B. Nuclear Technology (6 weeks at Stanford, or 2-3 week sessions)

Course C. Operator Training (4 weeks at Stanford)

Course D. Fuel Management (4 weeks at regional locations)

Course E. Steam Systems (4 weeks at Stanford)

Degrees are offered in nuclear engineering, nuclear physics, nuclear chemistry, and radiation biology.

For more information, contact: Director, Nuclear Engineering Division
Stanford University
Stanford, California 94305

O. Tennessee, University of

Provides the following short courses:

Nuclear Power Reactor Evaluation. The one-week course concerns the technical and economic evaluation of power reactors. Topics to be covered include design and performance features of converter and breeder reactors, fuel utilization characteristics of reactor systems and their influence on economics, reactor fuel cycles, fuel fabrication and processing costs, engineering evaluation of reactor cores, economic evaluation of reactor plants, and nuclear power costs. Relative performance of various reactor concepts is also considered. Either a B.S. in engineering of the equivalent background is required, with training or experience in nuclear engineering.

Protection Systems for Nuclear Power Plants. The course covers the principles of protection-system design, with emphasis on requirements and current practice in large water-cooled power reactors. Systems aspects will be emphasized; knowledge of electronics and instrument design is not required. Course is intended for persons in industry, government, or universities who have substantial background in an engineering or scientific discipline, who wish to acquire a knowledge of the principles of protection-system design for nuclear facilities.

Degrees are offered in nuclear engineering, nuclear physics, radiochemistry, and health physics.

For more information, contact: Director of Conferences and Institutes
2004 Ogden Avenue
Knoxville, Tennessee 37916

P. University of California at Los Angeles

Present courses include the following:

Nuclear Reactor Operations. A comprehensive introduction to nuclear reactor ooerations, designed to prepare the student for the AEC reactor operator's license examination. Lectures, demonstrations, experiments and individual operation of the UCLA training reactor are used to develop the student's skills and self-confidence. (12 meetings) Prerequisite: Algebra and physics, or consent of instructor.

Radiation Effects in Electronics. The effects of nuclear radiations from various sources, including reactors, nuclear weapons, cosmic radiation, and solar flares on electronic devices and systems. (12 meetings) Prerequisite: B.S. in engineering or science or consent of instructor.

Nuclear Safety. Nuclear safety, its past history, present status, and the needs and prospects of the future. Sources and properties of nuclear radiation and human effects; case histories of nuclear accidents; present techmiques in reactor safety, including reactivity excursions, cooling, containment and siting; general concepts of reactor safety, regulations, criteria, and future prospects. (12 meetings) Prerequisite: Engineering XL 135A and B or equivalent, or consent of instructor.

Modern Developments in Nuclear Engineering. This course is for engineers interested in the design of large nuclear power plants and problems associated with them. Topics include: fuel and materials, kinetics, economics, safety, pulse and wave phenomena; reactor response to Seismic Loads; new methods in nuclear engineering including flux synthesis, invarient imbedding, and multidimensional transport theory. Experiments are performed in areas of pulse and wave phenomena and seismic loading, using the UCLA nuclear reactor. Prerequisite: B.S. degree in engineering, science or equivalent.

Planning a course in reactor operations and a short course for utility administrators and executives.

M.S. and Ph.D. courses have graduated 35 nuclear engineers.

For more information, contact: Department K
University of California Extension
P. O. Box 24901
Los Angeles, California 90024

Q. Virginia, University of

Special summer courses for non-engineers in reactor operation and health physics will be given on request.

M.S. and Ph.D. courses have produced 26 graduates.

For more information, contact: Chairman, Dept. of Nuclear Engineering
University of Virginia
Charlottesville, Virginia 22901

R. Western New York Research Center

Provided Phase-1 and -1b training for Nine Mile Point BWR supervisory staff and engineers. Is planning a basic training facility for power reactor operators.

For more information, contact: Director
Western New York Research Center, Inc.
Power Drive
Buffalo, New York 14214

S. Wisconsin, University of

Provides the following short courses:

Nuclear Power and Reactor Experiments to acquaint graduate engineers with the basic fundamentals of nuclear processes, reactors, and reactor power plants. It will combine lectures, reactor laboratory experiments and demonstrations.

Nuclear Reactor Materials to provide a survey of the material requirements, limitations, and specific problems associated with the use of materials in nuclear reactors. Designed for the engineer (not necessarily having a materials background) concerned with nuclear component behavior and material suitability. Engineering degree preferable.

Fuel Management for Nuclear Reactors to provide an introductory treatment of fuel management intended for college-trained persons with operations responsibility in the nuclear power field. Design basis and comparison of current generation PWRs and BWRs; reactor analysis; core calculations under various operating conditions; core calculations through lifetime to refueling; reactor tour with description and demonstration of operating system; initial fuel loading and criticality.

B.S., M.S., and Ph.D. courses have produced 59 nuclear engineering graduates.

For more information, contact: Chairman, Dept. of Nuclear Engineering
University of Wisconsin
Madison, Wisconsin 53706

IX. UNIVERSITIES WITH CURRICULA APPROPRIATE TO NUCLEAR POWER ENGINEERING

Alabama, University of Department of Physics	Birmingham, Alabama 35233
Arizona, University of Department of Nuclear Engineering	Tucson, Arizona 85721 NSE - Lynn E. Weaver
Arizona State University of Department of Nuclear Engineering	Tempe, Arizona 85281
Arkansas, University of Medical Center	Little Rock, Arkansas
Auburn University Dean, Graduate School Department of Radiological Sciences	Auburn, Alabama 36830 NSE - William V. Parker USPHS
Brooklyn, Polytech Institute of Department of Physics	Brooklyn, New York 11201 NSE - Deo C. Choudbury
California Institute of Technology Division of Engineering and Applied Sciences	Pasadena, California 91109 NSE - Harold Lurie
California, University of Department of Nuclear Engineering Department of Medical Physics School of Public Health	Berkeley, California 94720 NSE - Harvey Amster HP - Roger Wallace USPHS
California, University of Department of Applied Science	Davis, California 95616 NSE - Wilson K. Talley
California, University of Nuclear Energy Laboratory Department of Radiology	Los Angeles, California 90024 NSE - T. E. Hicks USPHS
California, University of Department of Chemical and Nuclear Engineering	Santa Barbara, California 93106
Carnegie-Mellon University Department of Mechanical Engineering	Pittsburgh, Pennsylvania 15213 NSE - William F. Stokey
Case Western Reserve University Division of Engineering	Cleveland, Ohio 44106 NSE - Floro Miraldi

Catholic University of America Department of Nuclear Science and Engineering	Washington, D. C. 20017 NSE - E. D. Jordan
Chicago, University of Department of Radiology	Chicago, Illinois 60637 USPHS
Cincinnati, University of Nuclear Science and Engineering Program Department of Radiology	Cincinnati, Ohio 45221 NSE - James H. Leonard USPHS
Clarkson College of Technology Department of Chemical Engineering	Potsdam, New York 13676 NSE - Thomas J. Ward
Colorado State University Department of Mechanical Engineering Department of Radiology and Radiation Biology	Fort Collins, Colorado 80521 USPHS
Colorado, University of Department of Aerospace Engineering Science	Boulder, Colorado 80302 NSE - Mahinder S. Uberoi
Columbia, University of Department of Nuclear Science and Engineering Department of Radiology	New York, New York 10027 NSE - Charles Bonilla USPHS
Connecticut, University of Department of Physics	Storrs, Connecticut 06226 NSE - Frederick E. Steigert
Cornell University School of Engineering Physics	Ithaca, New York 14850 NSE - T. R. Cuykendall
Delaware University Department of Electrical Engineering	Newark, Delaware 19711
Denver, University of Department of Chemical Engineering	Denver, Colorado 80210 NSE - Richard G. Griskey
Drexel Institute of Technology Department of Physics	Philadelphia, Pa. 19104 NSE - Kenneth Oebler
Emory University Department of Radiology	Atlanta, Georgia 30322 USPHS
Florida, University of Dean of Engineering Dept. of Civil Engineering & Radiology	Gainesville, Florida 32601 NSE - Robert E. Uhrig

Georgia Institute of Technology School of Nuclear Engineering School of Physics	Atlanta, Georgia 30332 NSE - C. J. Roberts HP - James R. Stevenson USPHS
Harvard University Department of Industrial Hygiene	Cambridge, Massachusetts 02138 HP
Idaho State University Department of Nuclear Science and Engineering	Pacatello, Idaho 83201
Illinois, University of Nuclear Engineering Program	Urbana, Illinois 61801 HP, NSE - Marvin E. Wyman
Iowa State University Department of Nuclear Engineering Department of Civil Engineering	Ames, Iowa 50010 NSE - Glenn Murphy USPHS
Johns Hopkins University School of Public Health and Hygiene	Baltimore, Maryland USPHS
Kansas State University Department of Nuclear Engineering	Manhattan, Kansas 66502 NSE - W. R. Kimel
Kansas, University of Dept. of Chemistry and Petroleum Engineering Department of Radiation Biophysics	Lawrence, Kansas 66044 NSE - Russell B. Mesler HP - Frank Noecker
Kentucky, University of Department of Mechanical Engineering	Lexington, Kentucky 40506 NSE - O. J. Hahn
Long Island University - C. W. Post College Department of Physics	Greenvale, Long Island, N.Y. 11548
Louisiana State University Nuclear Science Center	Baton Rouge, Louisiana 70803 NSE - Harry D. Richardson
Louisville, University of Speed Scientific School	Louisville, Kentucky 40208 NSE - R. C. Ernst
Lowell Technological Institute Nuclear Engineering Department	Lowell, Massachusetts 01854
Marquette University Department of Mechanical Engineering	Milwaukee, Wisconsin 53233 NSE - B. L. Richardson
Maryland, University of Department of Chemical Engineering	College Park, Maryland 20742 NSE - Joseph Silverman

Massachusetts Institute of Technology Dept. of Nuclear Engineering	Cambridge Massachusetts 02139 NSE - Manson Benedict
Miami, University of Department of Radiology	Coral Gables, Florida 33124 USPHS
Michigan State University Department of Civil and Sanitary Engineering	East Lansing, Michigan 44823 USPHS
Michigan Technological University Department of Nuclear Engineering	Houghton, Michigan 49931 NSE - Donald A. Daavettila
Michigan, University of Dept. of Nuclear Engineering School of Public Health	Ann Arbor, Michigan 48105 NSE - John S. King HP - G. Hoyt Whipple USPHS
Minnesota, University of Deparment of Chemical Engineering School of Public Health	Minneapolis, Minnesota 55455 NSE - Herbert S. Isbin HP - Gaylord W. Anderson USPHS
Mississippi State University Dept. of Nuclear Engineering	State College, Mississippi 39762 NSE - J. I. Paulk
Mississippi, University of Dept. of Chemical Engineering	University, Mississippi 39762 NSE - Russell E. Aven
Missouri, University of Dept. of Nuclear Engineering	Columbia, Missouri 65201 NSE - Robert P. Morgan
Missouri, University of Dept. of Metallurgical Engineering	Rolla, Missouri 65401 NSE - D. S. Eppelsheimer
Nevada, Univesity of Dept. of Nuclear Engineering	Reno, Nevada 89507 NSE - David F. Dickinson
New Hampshire University Department of Chemical Engineering	Durham, New Hampshire 03824
New Mexico, University of Dept. of Nuclear Engineering	Albuquerque, New Mexico 87106 NSE - Glenn A Whan
New York, State University of Dept. of Nuclear Engineering	Buffalo, New York 14214
New York University Dept. of Nuclear Engineering Institute of Environmental Engineering	New York, New York 10453 NSE - John R. Lamarch HP - Merrill Eisenbud USPHS

Newark College of Engineering Department of Physics	Newark, New Jersey 07102
North Carolina State University Dept. of Nuclear Engineering	Raleigh, North Carolina 27607 NSE - Thomas S. Elleman
North Carolina, University of School of Public Health	Chapel Hill, North Carolina 27514 USPHS
North Dakota State University School of Pharmacy	Fargo, North Dakota 58102 USPHS
Northwestern University Dept. of Engineering Sciences The Technological Institute	Evanston, Illinois 60201 NSE - Donald T. Eggen USPHS
Notre Dame, University of Dept. of Mechanical Engineering	Notre Dame, Indiana 46556 NSE - Edward W. Jerger
Ohio State University Dept. of Nuclear Engineering	Columbia, Ohio 43210 NSE - William M. Proteroe
Oklahoma State University School of Chemical Engineering	Stillwater, Oklahoma 74074 NSE - J. B. West
Oklahoma, University of School of Aerospace and Mechanical Engineering	Norman, Oklahoma 73069 NSE - David M. Elliott USPHS
Old Dominion College School of Engineering	Norfolk, Virginia 23508
Oregon State University Institutes of Nuclear Science and Engineering Radiation Center	Corvallis, Oregon 97331 NSE - C. H. Wang USPHS
Pennsylvania State University Nuclear Engineering Department	University Park, Pa. 16802 NSE - W. F. Witzig
Pennsylvania, University of Dept. of Radiology	Philadelphia, Pa. 19104 USPHS
Pittsburgh, University of Dept. of Metallurgical Engineering Graduate School of Public Health	Pittsburgh, Pa. 15213 NSE - J. A. Berger HP - Allen Brodsky USPHS
Princeton University Dept. of Chemical Engineering	Princeton, New Jersey 08540 NSE - R. C. Axtmann
Puerto Rico, University of Division of Nuclear Engineering Puerto Rico Nuclear Center	Mayaguez, Puerto Rico 00708 NSE - D. S. Sasscer HP - Henry Gomberg

Purdue University Dept. of Bionucleonics Assistant Dean of Graduate School	West Lafayette, Indiana 47907 HP - Paul Zimer NSE - W. E. Bergdolt
Rensselaer Polytechnic Institute Dept. of Nuclear Engineering and Science Dept, of Environmental Engineering	Troy, New York 12181 NSE - V. L. Parsegian USPHS
Rhode Island, University of Dept. of Chemical Engineering	Kingston, Rhode Island 02881 NSE - Vincent C. Rose
Rice University Department of Physics	Houston, Texas 77001 NSE - J. R. Risser
Rochester, University of Dept. of Radiation Biology and Biophysics	Rochester, New York 14620 HP - J. Newell Stannard
Rutgers, The State University Dept. of Mechanical and Aerospace Engineering Radiation Science Center	New Brunswick, New Jersey 08903 NSE - Francis J. Jankowski HP - Frank G. Dunnington USPHS
South Carolina, University of Dept. of Chemical Engineering	Columbia, South Carolina 29208 NSE - B. L. Baker
South Dakota State University Dept. of Mechanical Engineering	Brookings, South Dakota 57006
Stanford University Dept. of Mechanical Engineering	Stanford, California 94305 NSE - T. J. Connolly
Temple University School of Pharmacy	Philadelphia, Pa. 19122 USPHS
Tennessee, University of Dept. of Nuclear Engineering Dept. of Physics	Knoxville, Tennessee 37916 NSE - P. F. Pasqua HP - Robert G. Lovell
Texas A and M University Dept. of Nuclear Engineering	College Station, Texas 77843 NSE - R. G. Cochran HP - R. D. Neff
Texas Technical College School of Engineering	Lubbock, Texas 79409 NSE - John R. Bradford
Texas, University of, at Austin Dept. of Physics College of Engineering	Austin, Texas 78712 NSE- R. N. Little USPHS
Tulane University Dept. of Mechanical Engineering	New Orleans, Louisiana 70118 NSE - D. C. Hamilton

Tuskegee Institute School of Engineering	Tuskegee Institute, Alabama 36088 NSE Z. W. Dybczak
Utah, University of Dept. of Mechanical Engineering	Salt Lake City, Utah 84112 NSE - Gary M. Sandquist
Utah State University Dept. of Mechanical Engineering	Logan, Utah 84321
Vanderbilt University School of Engineering Dept. of Physics and Astronomy	Nashville, Tennessee 37203 NSE - John H. Dunlap HP - Charles R. Roos
Virginia Polytechnic Institute Department of Physics	Blacksburg, Virginia 24061 NSE - Andrew Robeson
Virginia, University of Dept. of Nuclear Engineering	Charlottesville, Virginia 22901 NSE - T. G. Williamson
Washington State University Dept. of Chemical Engineering	Pullman, Washington 99163 NSE - Harry Stern
Washington, University of Dept. of Nuclear Engineering Dept. of Radiology	Seattle, Washington 98105 NSE - Albert L. Babb HP - Kenneth L. Jackson
Wayne State University Dept. of Radiology	Detroit, Michigan 48202 USPHS
West Virginia University Dept. of Chemical Engineering	Morgantown, West Virginia 26506 NSE - G. Lansing Blackshaw
Wisconsin, University of Dept. of Nuclear Engineering	Madison, Wisconsin 53706 NSE - Charles W. Maynard
Worcester Polytechnic Institute Associate Dean of the Faculty	Worcester, Massachusetts 01609 NSE - Richard F. Morton
Wyoming, University of Dept. of Chemistry	Laramie, Wyoming 82070 NSE - V. A. Ryan
Yale University School of Medicine	New Haven, Connecticut 06520 USPHS

Note: NSE indicates schools participating in AEC Nuclear Science and Engineering fellowship programs; HP, in AEC Health Physics fellowship programs. Adjacent names are fellowship advisors. Departments shown are sources of possible contacts. All fellowship advisors are shown on the same line as their department titles.

USPHS indicates that PHS supports a radiological physics program.

X. TECHNICAL INSTITUTES AND COMMUNITY COLLEGES WITH CURRICULA RELATED TO NUCLEAR POWER ENGINEERING

CALIFORNIA

Chabot College Nucleonics Technology	2555 Hesperian Boulevard Hayward, California 94545
El Camino College Radiation Technology	El Camino, California 90506
Los Angeles Valley College Nucleonics Technology	5800 Fulton Avenue Van Nuys, California
Pasadena City College Nucleonics Technology	1570 E. Colorado Boulevard Pasadena, California 91106
Phineas Banning Adult School Nucleonics Technology	15500 N. Avalon Boulevard Wilmington, California 90744
San Bernadino College Combustion Power	710 S. Mt. Vernon Avenue San Bernadino, California 92403
South Gate Adult School Combustion Power	3551 Firestone Boulevard South Gate, California 90280

CONNECTICUT

Hartford State Technical College Nuclear Technology	401 Flatbush Avenue Hartford, Connecticut 06115

DISTRICT OF COLUMBIA

Capital Radio Engineering Institute Nuclear Engineering Technology Nuclear Instrumentation and Control	3224 Sixteenth Street, N. W. Washington, D. C. 20010

FLORIDA

Central Florida Junior College Radiation Technology	P. O. Box 1388 Ocala, Florida 32670

Tampa Technical Institute Nucleonics Technology	209 N. Franklin Tampa, Florida 33602

IDAHO

Idaho State University Radiation Progection Technology	Pocatello, Idaho 83201

ILLINOIS

Sauk Valley College Radiation Technology	R. R. No. 1 Dixon, Illinois 61021

KANSAS

Garden City Community College Nucleonics Technology Combustion Power Technology	Garden City, Kansas 67846

LOUISIANA

Sowela Technical Institute Combustion Power Technology	501 Broad Street Lak Charles, Louisiana 70601

MARYLAND

Montgomery Junior College Radiation Technology	Takoma Park, Maryland 20012

MASSACHUSETTS

Lowell Technological Institute Nucleonics Technology Radiation Technology	1 Textile Avenue Lowell, Massachusetts 01854
Massachusetts Trades Shops School Combustion Power Technology	155 High Street Boston, Massachusetts 02110
Wentworth Institute Nuclear Engineering Technology	550 Huntington Avenue Boston, Massachusetts 02115

MICHIGAN

Ferris State College Electric Power Technology	901 S. State Street Big Rapids, Michigan 49307
St.Clair Shores Adult Education Combustion Power Technology	25901 Jefferson Avenue St. Clair Shores, Michigan 48081

MINNESOTA

Mankato Area Vocational-Technical School Combustion Power Technology	51 Park Lane Mankato, Minnesota 56001

MONTANA

Great Falls Public Schools Combustion Power Technology	P. O. Box 2669 Great Falls, Montana 59401

NEVADA

Southern Nevada Vocational Technical Center Radiation Technology	5710 Maple Street Las Vegas, Nevada 89109

NEW JERSEY

Camden County Vocational-Technical High School Nucleonics Technology	6008 Browning Road Pennsauken, New Jersey 08110

NEW YORK

Hudson Valley Community College Radiation Technology	Vandenburgh Avenue Troy, New York 12180
Jamestown Community College Combustion Power Technology	525 Falconer Street Jamestown, New York 14701
Manhattan College Radiological Health & Science Institute Radiation Biology, Chemistry and Physics Nuclear Instrumentation & Electronics Radiological Laboratory & Environmental Science	Evening Division Bronx, New York 10471

NORTH CAROLINA

Fayetteville Technical Institute Combustion Power Technology	P. O. Box 5236 Fayetteville, North Carolina 28306

OKLAHOMA

Oklahoma State R. Technical Institute Radiation Technology	Stillwater, Oklahoma 74074

OREGON

Lane Community College Combustion Power Technology	200 N. Monroe Street Eugene, Oregon 97401
Oregon Technical Institute Health Physics Technology H. P. Plant Operator Technology	Oretech Branch Klamath Falls, Oregon 97601
Oregon State University Nuclear Power Engineering Technology	Corvallis, Oregon

PENNSYLVANIA

Dobbins Area Vocational Technical School Radiation Technology	Lehigh Avenue Philadelphia, Pennsylvania 19132
Penn State University Nuclear Technology	University Park, Pennsylvania 16802
Spring Garden Institute Combustion Power Technology	2815 N. 17th Street Philadelphia, Pennsylvania 19132
Williamsport Area Community Combustion Power Technology	1005 W. Third Street Williamsport, Pennsylvania 17701

TENNESSEE

Chattanooga State Technical Institute Radiation Technology	4501 Amnicola Hiway Chattanooga, Tennessee 37406

VIRGINIA

Old Dominion College Nucleonics Technology	Norfolk, Virginia 23508

WASHINGTON

Skagit Valley College Combustion Power Technology	Mt. Vernon, Washington 98273